A Hybrid Course for Probability and Statistics for Engineers: A Readiness Study at Shahid Beheshti University

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***Abstract*—Probability and Statistics for Engineers covers verities of subjects in the set theory, the combinatory analysis, probability, statistics, and (in some universities) the stochastic processes. Since, course receives only 3 credits it has to be thought 3 hours/week. This overloading content along with time limitation make course as a challenging and difficult one for students. Also, many instructors, including the first author, found the course very challenging to teach. Two popular on-site and e-learning training systems do not provide any appropriate solution. This article suggests a hybrid training system, which combines some elements of both training systems to reduce the disadvantages of both systems. Readiness of such hybrid course is measured by preparedness of students for online activities. The readiness study at Shahid Beheshti University shows that *Internet skills, self-directed learning, learner attitude toward e-learning, e-mail skills,* and *software ability* of students are factors which are significantly affect *readiness* of students.**

***Index Terms*—Readiness, Hybrid course, Probability and Statistics for Engineers, E-learning.**

I. INTRODUCTION

Probability and Statistics for Engineers is one of the challenging courses for both instructors and students in engineering. Overloading of the course content, time limitation, and simultaneous offering the course with several difficult courses (such as fundamental of physics, multivariate calculus, differential equations) transform an interesting course to a difficult one. Some instructors suggest dropping some less important materials of the course, and teaching the rest with more care. But, the majority of them believe that the course contents have been chosen based upon students' needs in other courses and their research. Therefore, it is reasonable to employ a training system which have no time limitation and can be adapted based upon learners' abilities.

An e-learning training system can provide an interactive, individualized, and repeatable environment to teach a subject. Universities are witnessing many benefits of e-learning, such as cost saving, increasing flexibility, productivity, rapidly developing, deploy and update a course, providing an effective training system, availability anytime and anywhere, providing broadly training opportunities, staying competitive, improving motivation and morale, and implementing strategic initiatives more effectively (Bonk, 2002; So and Swatman, 2007; Minton, 2000). On the other hand, there are situations where an e-learning training system is not an appropriate one. Many instructors believe that mathematics and statistics need the traditional face-to-face training system and they cannot teach using an online training system (Broadbent, 2001 and Chapnick, 2000).

To overcome such barriers and limitations, several authors suggest using a hybrid course; see Garnham and Kaleta (2002) and Sands (2002), among others for more detail. Many universities have sought to develop their own hybrid learning courses as another option for students and instructors who prefer to replace some portion of traditional face-to-face meeting time with online instruction (Olapiriyakul & Scher, 2006). In a hybrid training system, similar to the traditional training system, students participate in a classroom and learn significant portion of the course on-site. But, some complimentary activities such as advanced topics, assignments, quizzes, more examples, and etc are moved to an online part. The goal of hybrid courses is to join the best features of in-class teaching with the best features of online learning to promote active independent learning and reduce class seat time (Garnham and Kaleta, 2002). Moreover, Arbaugh (2000) pointed out that hybrid courses may be accompanied benefits of both on-site and e-learning techniques to reduce disadvantages of both techniques. To have a successful hybrid course an instructor must invest significant time and effort in redesigning a traditional course. Since, online activities require special abilities, equipments, and etc. of learners. Garnham and Kaleta (2002) pointed out that readiness of a hybrid course measured by preparedness, mentally or physically, of learners in online activities.

Sands (2002) described how one may integrate online activities with classroom work to obtain a successful hybrid course. Based upon Sands' suggestions, our experience, and several in-deep interview with some experts and instructors, we decide to design a hybrid course, which (**i**) the course contents teach in the On-site part; (**ii**) Class materials companies with some new examples and more advanced materials as well as quizzes and assignments are moved to the On-line part.

This article reports the readiness of Shahid Beheshti university (say SBU) students, who registered the course in 2009 winter semester. This article develops as the following. Section 2 reviews some relevant literature regarding readiness. Research's hypothesizes as well as statistical methods are given in Section 3. Research's design is given in Section 4. While Section 5 represents results of the research. Finally, Section 6 provides a conclusion regarding our findings.

II. LITERATURE REVIEW

Webster's New Collegiate Dictionary defines readiness as being prepared, mentally or physically, for some experience or actions. Borotis and Poulymenakou (2004) defined e-learning readiness of an organization as preparedness, mentally or physically, for some e-learning experience or actions.

Kaur and Abas (2004), Anderson (2002), Bean (2003), Chapnick (2000), Clark and Mayer (2003), and Gold et al. (2001) are authors, among others, who discussed the necessity of a readiness study in an e-learning training system. They warned that without a careful planning most likely an e-learning system will be ended with cost overruns, unappealing training products, and failure. Moreover, they stated that (similar to any other major innovations) e-learning strategies require considerable up-front analysis, development time, money, technological infrastructure, and leadership support to be successful. Therefore, managers must assess their companies' readiness for an e-learning system, before implementing this innovation. Several authors studied factors which may affect readiness of learners. Table 1 summarizes some of their results.

III. VARIABLES AND HYPOTHESIZES OF RESEARCH

A two-section survey entitled, *"e-Learning Readiness Survey"* has been developed to assess e-learning readiness of students at SBU, who registered the course in 2009 winter semester. The first section consisted of 5 items to gather data about demographic characteristics, such as gender, scholastic success (which is measured by Grad Point Average, GPA), major, computer usage, and Internet usage in the week who takes the survey. The second section included 41 items to assess respondents' self-report perceptions of their readiness for an e-learning training system. Now observe that: (i) the On-line part of the hybrid training system is a new part, which added to the traditional part. Therefore, it is reasonable to measure readiness of learners for the hybrid training system through their readiness for an online training system; (ii) Readiness defines based upon mentally and physically preparedness of students who will participate the course. From these observations one can conclude that, readiness of the hybrid training system (dependent variable) can be measured, only, by students' online preparedness, mentally and physically, using questions 1 to 9. It is worth to mention that questions 1 to 5 assesses the mental readiness while questions 6 to 9 assess the physical readiness of students in the survey.

DeVellis (2003) indicated that the first step in developing an instrument is, clearly, determining what it is the researcher wants to measure. The variables, or factors, of this research identified after detailed analyses of the available e-learning readiness assessment instruments, and authors' personal experience. As a result, 12 major factors that can be helped organizations to measure how ready they are for an e-learning training system are identified.

Based upon previous researches, partly given in Section 2, a questionnaire developed to measure readiness of a learner for the online course. Appendix A represents the questionnaire items as well as their sources. Now, the followings present the hypotheses of this research.

Hypothesis 1. Skills of users influence **on learners' readiness for an online course.**

Learners with high skills have more confident to accomplish e-learning activities and improve their satisfaction. Many studies explore influences of self-efficiency on users' recognition effects. Wang and Newlin (2002) from a research, on 122 students, concluded that students with higher skills are more inclined to adopt a network-based learning system and earned, significantly, better final grades. Users' Skills which considered in this study are learners' ability to evaluate their ability to use the software, hardware, e-mail and Internet to perform an e-Learning activity.

Hypothesis 2. **Self-directed ability of learners influences learners' readiness for an online course.**

In an online course, a learner goes through instructional material, delivered via the Web, at his/her own pace with no (more precisely, with minimal) interaction from an instructor. Self-directed of learners is a factor which can be used to measure whether or not a leaner can stand alone, whenever an instructor is not available (Haney, 2001). Piskurich (2003) believes an ability to work alone, persistence in learning, and ability to develop a plan to complete a work are such skills which may affect readiness of e-learners.

Hypothesis 3. **Learners' attitude toward an online course influences on their readiness for the course.**

Arbaugh (2002), Hong (2002), and Piccoli et al. (2001) are such authors, among others, who believe that learner's

TABLE I.
FACTORS AFFECTING LEARNERS' READINESS

Author	Factors
Schreurs et al (2009)	Resources (technological and human readiness), education, environment
Koo (2008)	Individuals' language, discipline, experience in using e-mail, skill levels
So and Swatman (2007)	Students' preparedness, teachers' preparedness, infrastructure, management Support, school culture, preference to meet face-to-face.
Sun et al (2007)	Learner attitude toward computer, learner computer anxiety, technology quality, Internet quality.
Liu (2005)	Trainee characteristics, training content, system design, working environment.
Gunawardana (2005)	Instructional material, tutorial support, communication, collaboration
Haney (2002)	Employee competency, development needs, career paths and records, course tracking technology, infrastructure, supporting finance, vendor offerings.
Chapnick (2000)	Psychological, sociological, human-resource, financial, technological skill (aptitude), equipment, content readiness.
Gastaldo et al (2005)	User characteristics, accessibility to computer equipment, knowledge, attitudes toward ICT

attitude, towards e-learning, are an important factor in e-learning readiness. Learner's attitude can be defined as learner's impression to participate in an e-learning activity. Instructors post their materials on the platform and learners participate through computer networks. A more positive attitude toward e-learning, for example, when students are not afraid of the complexity of using computers, will result in more satisfaction and effectiveness of learners in an e-learning environment (Piccoli et al., 2001). Furthermore, positive attitudes toward e-learning increase the chances of success of an e-learning system, while negative attitudes reduce it. Therefore, this research considers learners' attitude towards computers as an important factor in e-learning readiness.

Hypothesis 4. **Learners' computer anxiety influences on their readiness for an online course.**

Piccoli et al. (2001) believe computer anxiety, significantly, affects an e-learning environment. Computers are communication tools in e-learning environments. Therefore, any fear in computer usage would certainly hamper learning (Piccoli et al., 2001). Computer anxiety is an emotional fear which comes up some potential negative outcomes, such as damaging to equipments or looking foolish (Barbeite and Weiss, 2004). The higher computer anxiety causes the lower level of e-learning readiness. The definition of computer anxiety in this research is the level of learners' anxiety, when they apply computers.

Hypothesis 5. **Equipments influence on learners' readiness for an online course.**

Other factors contributing to an increase in e-learning readiness are the infrastructure of technology and technical support of an e-learning system. It is important to bring into account the reliability and quality of the system, because they play important roles in e-learning readiness. To build an acceptable e-learning environment, one has to maintain and up-to-date technology and material represented by the environment (Folorunso et al., 2006; Poon et al., 2004; Selim, 2005).

Hypothesis 6. **Scholastic success of learners, influence on learners' readiness for an online course.**

Carmel and Gold (2007) pointed out those learners who reported higher readiness tended to be more successful, scholastically.

Hypothesis 7. **Gender of learners influences on learners' readiness for an online course.**

Summer (1990) and McMahon and Gardner (1995) found out that male students experience less anxiety about ICT than female students. Moreover, Oliver (1993) and Van Braak (2001) discovered that female students have lower confidence or knowledge ability than males regarding computer usage. However, many other authors (such as Koohang, 1989; Kay, 1989; Hunt and Bohlin, 1993; Marshall and Bannon, 1986; Woodrow, 1991 among others) are agree with the claim that "*there are no significant different between attitude of male and female students regarding ICT usage*".

Hypothesis 8. **Major of learners influences on their readiness for an online course.**

Summers and Easdown (1996) mentioned that student's major and specialization are such factors which influence on e-learning's readiness.

IV. RESEARCH DESIGN

A series of in-depth interviews, with various experienced e-learning and instructors of the course, have been conducted to examine the validity of our research model. After that, questionnaire items developed based upon previous literature and comments gathered from the interviews. Questionnaires were revised with help from experts (including academics and practitioners) with significant experience in e-learning and Probability and Statistics. A 5-point Likert scale ranging from 1, as strongly disagrees, to 5, as strongly agrees, is used for the measurement.

A pretest, to measure validity and reliability of study, was conducted with 3 instructors and 2 e-learning's experts. Followed by pretest to verify reliability of questionnaire, a pilot test has been conducted using 20 randomly chosen students from the target population. Questions regarding skills of users, on line audio/video, self-directed leaning, learner attitude toward learning, leaner computer anxiety, equipments, and e-learning readiness can be summarized into 7 single factors $F_1,...,F_7$. The Cronbach's alpha from those factors are 80.2%, 75.34%, 95.01%, 89.32%, 73.02%, 89.54%, and 78.93% respectively, which indicate an acceptable reliability of the questionnaire.

The research population included all undergraduate students in computer and electronic majors, who registered in the Probability and Statistics course in 2009 winter semester at SBU (with population size N=130). After a pilot test, a census study was conducted by distributing the questionnaire among all students. This survey generated 109 useable responses from students resulting in a response rate of 83.8%, which is indicated that the respondents found the topic interesting and relevant.

This research used two statistical packages, Minitab 13, SPSS 16, to analyze the data. Data was analyzed using the following two techniques.

A. Ordinal Logistic Regression

The binary logistic regression is a well-known technique to set up a generalized linear model for the binary dependent variable. But for multiple ordinal dependent variables, the binary logistic regression does not work properly. Statisticians developed an ordinal logistic regression to handle multiple ordinal dependent variables. Minitab 13 is a statistical software package that can fit an ordinal logistic regression to data. The output of the software includes: (**1**) *Response and Factor Information*, which displays the number of observations and the response and factor categories; (**2**) *Logistic Regression Table,* which shows the estimated coefficients, p-values (related to a test that the corresponding coefficient is zero), and odds ratio (which shows effect of each variables on the model); (**3**) *Goodness-of-Fit Tests,* which displays both Pearson goodness-of-fit test of the model to data. The steps in model building for an ordinal logistic model are similar to those for the binary logistic regression model. Unfortunately, the full array of modeling tools is not available in the software packages. So, one has to choose a final and appropriate model by entering variables with significant coefficients (p-value<0.05) and ordering effect of variables from their Odds ratio (negative coefficient along smallest odds ratio indicate more impact of the variable on the dependent variable, McCullagh and Nelder, 1992). Finally, appropriative of model is evaluated by (**i**) a

TABLE II.
DEMOGRAPHIC PROFILE AND DESCRIPTIVE STATISTICS OF STUDENTS

Sex	Female (42.20%)	Male (57.80%)
Province	Tehran (77.78%)	Other (22.22)
Major	Computer (33.03%)	Electronic (66.97%)
Computer usage (daily)/hour	Mean=3.058 S.D=1.811	
Internet usage (daily)/hour	Mean=2.159 S.D=1.519	

TABLE III.
PERSONAL AND UNIVERSITY FACILITIES

Having Laptop	Yes (55.05)	No (44.95)
Having an appropriate personal computer	Yes (94.50)	No (5.50)
Internet connection at home*	Dial-up (60.55)	ADSL (9.17)
Internet connection at university*	Wireless (62.38)	Wire (27.72)
Having a cell-phone	Yes (100%)	No (0%)
Having an appropriate memory stick	Yes (88.07)	No (11.93)

*Contained some missing observations

G test wh ose its n ull h ypothesis states a ll the co efficients associa ted with pre dictors equal zero vers us at least one coefficient is not ze ro (we prefer to reject its null hypothesis, i.e., p-val ue <0.05) an d (**ii**) Goo dness-of-Fit Tests, (we prefe r to a ccept its null hypothesis, i.e., p-val ue >0.1), more can be foun d in Hosm er and Lemeshow (20 00) an d M cCullagh and Nel der (19 92), among others.

B. Contingency table

A co ntingency t able (or cr oss t abulation) describes the di stribution o f t wo or more vari ables sim ultaneously. Each cell shows the number of respon dents, who gave a speci fic combination of responses. Since contingency table is easy to understand, can be used with any kind of data, (the co ntingency tables treat no minal, ordinal, interval, and ratio scales as a nom inal scale), provides g reater i nsight t han si ngle st atistics, and ca n be used as a tool to measure association among variables is one of m ost pop ular techniques in statistics. I n a two-ways contingency table, there are several statistical tests can be used to test hypothesis:

$$H_o: \textbf{\textit{Row's Variable influences on variable in column,}}\ \textbf{vs.}\ H_1: \textbf{\textit{Rejection of}}\ H_o.$$

Which t he chi -square t est is t he most pop ular one. The sm all enoug h p -value o f t he t est (l ess than 0. 05) indicates that there is no evidence for association between these variables.

V. RESULTS AND DISCUSSION

Demographic pro file and descri ptive statistics of t arget population are summarized in Table 2.

Table 3 summarizes personal facilities and attitude of students about university facilities.

A. Ordinal Logistic Regression

As mentioned the above, sev eral 5-point Likert scale variables have been used to measure readiness of a learner (see Appendix A). To summarize such variables into a single one, say the dependent variable, one has to use t he m edian, w hich i s an appropriate central tendency for Like rt scale variables, see Agresti, 2003 a nd Johnson at al, 1999, among others. Therefore, readiness of each learner has 9 levels, b ecause median of those 5-point Li kert scal e vari ables generat es 1, 1. 5, 2, 2. 5, 3, 3.5, 4, 4.5, and 5.

To di scover a ffect of i ndependent vari ables t he dependent vari able an ordi nal l ogistic regressi on can be employed. The fol lowing t able represents coefficients, p-values and odds ratios of such ordinal logistic regression.

Results of Table 4 (bel ow) can be summarized as the following:

1. There is significant evidence to conclude that skills of u sers (e-m ail sk ills), sk ills o f u sers (software ability), sk ills o f u sers (In ternet sk ills), self-directed learn ing, and learn er attitu de to ward e-learning are s uch variables whose a ffect learning readiness, the dependent variable (their p-values is smaller than 0.05).
2. Small odds ratio i ndicates t hat im pact of si gnificant fact ors can be or dered a s (**1**) sk ills o f u sers (Internet sk ills), (**2**) self-di rected learning, (**3**) learner attitude toward e-learning, (**4**) sk ills of users (e-mail skills), and (**5**) skills of users (software ability).
3. P-value= 0.00 fo r test th at "all coefficie nts are zero" al ong with t he p-va lue= 0.89 9 fo r "t he Goodness-of-Fit Test s" i ndicate t hat the ordi nal logistic regressi on is an appr opriate model to analyze the data.
4. The ordi nal l ogistic regressi on gi ves 8 p arallel equations $(i = 1,2,...,8)$

$$\gamma_i = \frac{\exp\{\alpha_i - 3.212X_1 - 3.321X_2 - 0.232X_3 - 1.232X_4 - 2.330X_5\}}{1+\exp\{\alpha_i - 3.212X_1 - 3.321X_2 - 0.232X_3 - 1.232X_4 - 2.330X_5\}},$$

where γ_i is th e cu mulative p robability o f i^{th} level o f the dependent variable and $\alpha_1, \alpha_2, ..., \alpha_8$ are constant values, which given in Table 5.

TABLE IV.
ORDINAL LOGISTIC REGRESSION

	Dependent variable, i.e., efficiency of the model.			
	Coefficient	**P-value**	**Odds ratio**	**Rank order**
α_1	0.842 0.	042	___	___
α_2	1.805 0.	000	___	___
α_3	0.345 0.	001	___	___
α_4	0.352 0.	000	___	___
α_5	0.452 0.	000	___	___
α_6	2.452 0.	005	___	___
α_7	3.452 0.	021	___	___
α_8	4.320 0.	000	___	___
Skills of users (e-mail skills), say X_5	-2.330 0.	040	1.3335	5
Skills of users (hardware ability)	-0.321	0.091	0.211	-
Skills of users (software ability) , say X_4	-1.232 0.	000	1.321	4
Skills of users (Internet skills) , say X_1	-3.212 0.	003	0.210	1
Self-directed learning, say X_2	-3.321 0.	000	0.321	2
Learner attitude toward e-learning, say X_3	-0.232 0.	001	0.983	3
Learner computer anxiety	-0.302	0.230	0.442	-
Equipments (hardware)	-2.123	0.410	0.662	-
Equipments (software)	-0.091	0.621	0.421	-
Equipments (Internet)	-0.001	0.832	0.321	-
Online audio video	-0.129	0.785	3.211	-
p-value of goodness-of-fit test= 0.899				
p-value of test that "all coefficients are zero"= 0.002				

TABLE V.
HYPOTHESIS'S RESULT

Hypothesis number	**Chi-square statistic**	**Degree of freedom**	**p-value**	**Result on H_o at significant level $\alpha = 0.05$**
1 13.114		8	0.892	Accepted
2 4.893		8	0.231	Accepted
3 9.817		16	0.124	Accepted
4 3.	942	16	0.001	Rejected
5 0.	464	8	0.000	Rejected
6 3.515		8	0.102	Accepted
7 1.	596	8	0.009	Rejected
8 17.435		16	0.642	Accepted

B. Hypothesis tests:

As pointed out the above, readiness of each learners is a 9 level variable to test the given hypothesizes, one has to categorize the second variable in each hypothesizes into some levels. Population can be categorized into some groups regarding skills (low and high), self-directed ability (low and high), learners' attitude toward the online course (negative, neutral, and positive), learners' computer anxiety (negative, neutral, and positive), ICT's equipments (enough and lack), gender (male and female), major (computer sciences and Electronic), and scholastic success, according to their GPA (week, GPA< 12, average, $12 \leq$ GPA<17, and strong, GPA $\geq$ 17). The contingency analysis has been con

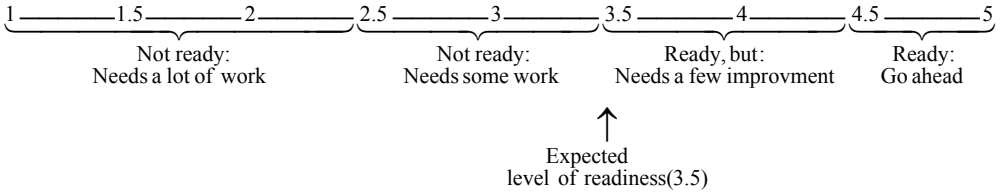

Figure 1. Discriminative index to identify level of readiness of each individual

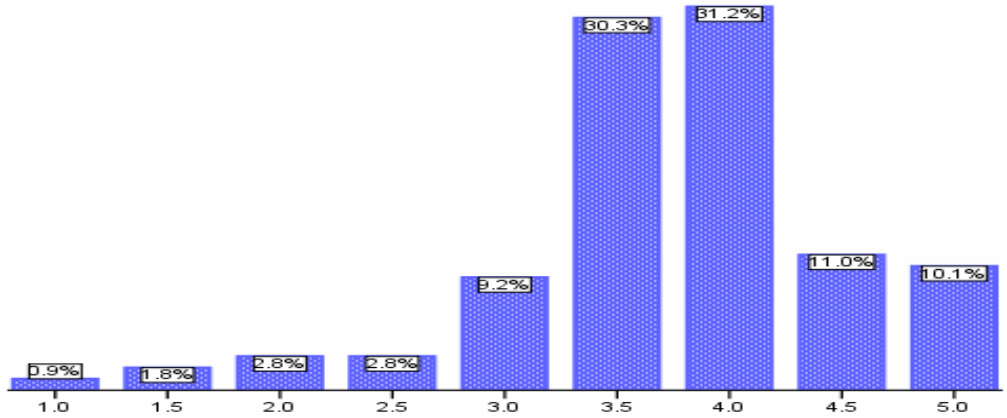

Figure 2. Distribution of the target population regarding level of readiness.

ducted to see test the given 8 hypothesizes. Results summarized in Table 4.

From Table 4, one can observe that:

1. Computer anxiety, equipment, and gender of students do not affect their readiness reading the online training system.
2. Skills, self-directed ability, attitude toward the online training system, scholastic, and major of students affect their readiness reading the training system.

In order to help managers of universities, we introduce a discriminative index to identify level of readiness of each individual. Figure 2 duplicates such index.

The bar chart above duplicates level of readiness of the target population, regarding the above discriminative index.

Using the discriminative index, provided by Figure 2, one can observe that, more than 80% of the target population is ready for the online course and consequently for the hybrid course. But, they need some improvements, which vary from an individual to another one.

VI. CONCLUSION AND SUGGESTION

This study made theoretical and practical contributions to the literature of the hybrid course readiness and more specifically on students' perceptions of the hybrid course implementation at SBU. The empirical results showed that the most of factors that were extracted from the data were genuinely significant in predicting the criterion variable. Our findings could have practical importance for any university as whose planning to implement such hybrid course. Universities, in their rush to implement the hybrid courses often place too much emphasis on the equipment and too little on the human part. So, this research comes up with authorizes must take a hard look at skills of users (Internet skills), self-directed learning, learner attitude toward e-learning, skills of users (e-mail skills), and skills of users (software ability) even thought other non-significant, statistically, factors should be taken in to account to have efficient and successful hybrid training system.

This study was the first part of a long term project, which designation and implementation of the hybrid course and study satisfaction and follow-up study are the last part of such project. Already, the second part of the project has been started. The On-line part of the hybrid course available at: http://faculties.sbu.ac.ir/~payandeh/efront/www/index.php?logout=true, where students in summer semester, in 2009, used it to write quizzes, download and upload assignments, and review the course materials.

To design the website, we use an open source Web designer named *Efront*. Efront provides ability to the Web administrator to orient e-learners' activities by (**i**) defining some rules for e-learners; (**ii**) providing a complete database about activities of e-learners on the webpage; (**iii**) ability to assign, randomly, a quizzes to learners. Other Efront's abilities may be found in Zaharia (2007) and its official website available at http://www.epignosis.com.gr/.

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APPENDIX A. QUESTIONNAIRE ITEMS AND SOURCES

Independent variables	Items	Sources
Skills of users	How confident do you feel about:	Nakhoda et al (2006), SORT website
Email skills	1. Logging in and out of your account? 2. Sending and receiving mail? 3. Attaching and downloading files? (Likert's scale 1, strongly disagree; 5, strongly agree)	
Hard ware ability	How confident do you feel about: 1. Using a keyboard and mouse? 2. Basic troubleshooting skills, such as rebooting the computer in case of a crash and resolving printer errors? 3. Changing printer ink cartridges? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006), SORT website
Soft ware ability	How confident do you feel about: 1. Working with fi les, such as creating, saving , a nd printing documents? 2. Installing software? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006), SORT website
Internet ability	How confident do you feel about : 1. Logging on to your Internet ser vice provid er and navigating to different Web addresses? 2. The advanced Internet skills, such as using a search engine, identifying and downloading appropriate files, or updating software via Internet? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006); Joo et al (2000) SORT website
Online Audio/Video	I think that I would be able to: 1. Relate the content of short v ideo clips (1 -3 minutes ty pically) to the information I have read online or in books. 2. Take notes while watching a video on the computer. 3. Understand cour se related info rmation when it's pres ented in video formats.	Watkins et al (2004)

Self-directed learning	Are you able to: 1. Learn without assistance of instructors? 2. Resist distra ctions a nd stay on task while working or studying? 3. Keep up with your assignments, and meet deadlines? 4. Manage your time appropriately? 5. Complete things on time?	Guglielmino an d Guglilmino (2002) Kim (2005); Graeve (1987); Straka et al (1994)
Learner attitude toward e-learning	I believe that e-learning : 1. is very difficult (R) 2. is very complicated (R) 3. requires technical ability (R) 4. let me feel psychological stress very greatly (R) 5. can be done only if one knows a programming language such as Basic (R) 6. is only advisable for people with a lot of patience (R) 7. makes a person more productive at his/her job 8. is for young people only (R) (Likert's scale 1, strongly disagree; 5, strongly agree)	Gattiker and Hlavka (1992)
Learner computer anxiety	I think: 1. Working with a computer would make me very nervous 2. I get a sinking feeling when I think of trying to use a computer 3. Computers make me feel uncomfortable 4. Computers make me feel uneasy and confused (Likert's scale 1, strongly disagree; 5, strongly agree)	Barbeite and Weiss (2004)
Equipments	Do you have:	SORT website
Hard ware	1. A consistent and convenient access to a computer? 2. A sound phones or speakers and microphone? 3. A working printer? 4. A CD-ROM drive? 5. A flash-stick memory? 6. A laptop?	Watkins et al (2004)
Software	Do you have: 1. A Web browser, such as safari , fire-fox, Intern et explor er, on your computer? 2. A virus protection software on your computer? 3. The Microsoft package on your computer?	SORT website Watkins et al (2004)
Internet	Do you have: 1. A reliable Internet connection? 2. A high-speed Internet connection?	SORT website Watkins et al (2004)
Dependent variables	**Items**	**Sources**
readiness	1. I have enough IT skills to use e-learning technologies. 2. My par ents are read y to suppo rt the use of e-learning at home. 3. I think I am ready for e-learning 7. I think I am rea dy to take m y q uizzes, assignments, extra examples from the web. 8. I think I am ready to communicate with instructors and students via the web. 4. I think it is the right tim e to promote e-learning in universities 5. Taking this c lass in this m anner allow m e to a rrange m y work for the class more effectively. 6. The advantages of taking this class in this mann er outweigh any disadvantages 7. Taking this class in this manner allow me to see course lectures which I was absent in that lessons (Likert's scale 1, strongly disagree; 5, strongly agree)	Arbaugh(2000) Thurmond et al (2002) So and Swatman (2007) And self-development